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(71) Applicant(s)
Bend All Manufacturing Inc.
(Incorporated in Canada - Ontario)
Weydom Drive RR 1, Ayr, Ontario N0B 1E0, Canada

(72) Inventor(s)
Horst Udo Petersen

(74) Agent and/or Address for Service
Anthony Asquith
328 Leeds Road, Scholes, LEEDS, LS15 4DD,
United Kingdom

(54) Abstract Title
Securement of head rest support into automobile seat frame

(57) The headrest support tubes are secured to the seat frame member not by the usual welding, but by gripping the web of the member between two rings 34,42 for lock-beads swaged into the metal of the tube. The first ring is swaged-out by compressing the tube. The tube, with the one ring, is then assembled into a through-hole in the web of the frame member. Then, the second ring is swaged into the metal of the tube, on the other side of the web, and the web lies gripped between the rings. The seat frame member may be an I-section extrusion, or a round tube with localised squeezed-flat areas, flanked by flanges.

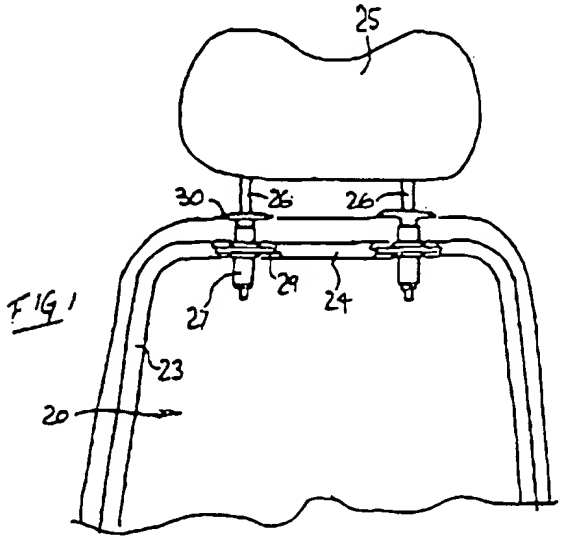

FIG 1

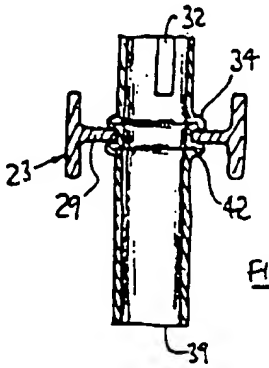

FIG 5

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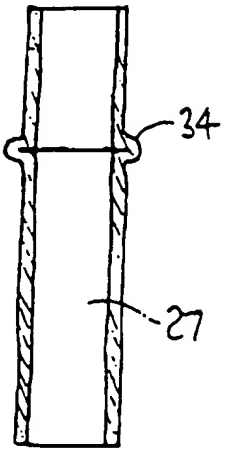

FIG 2

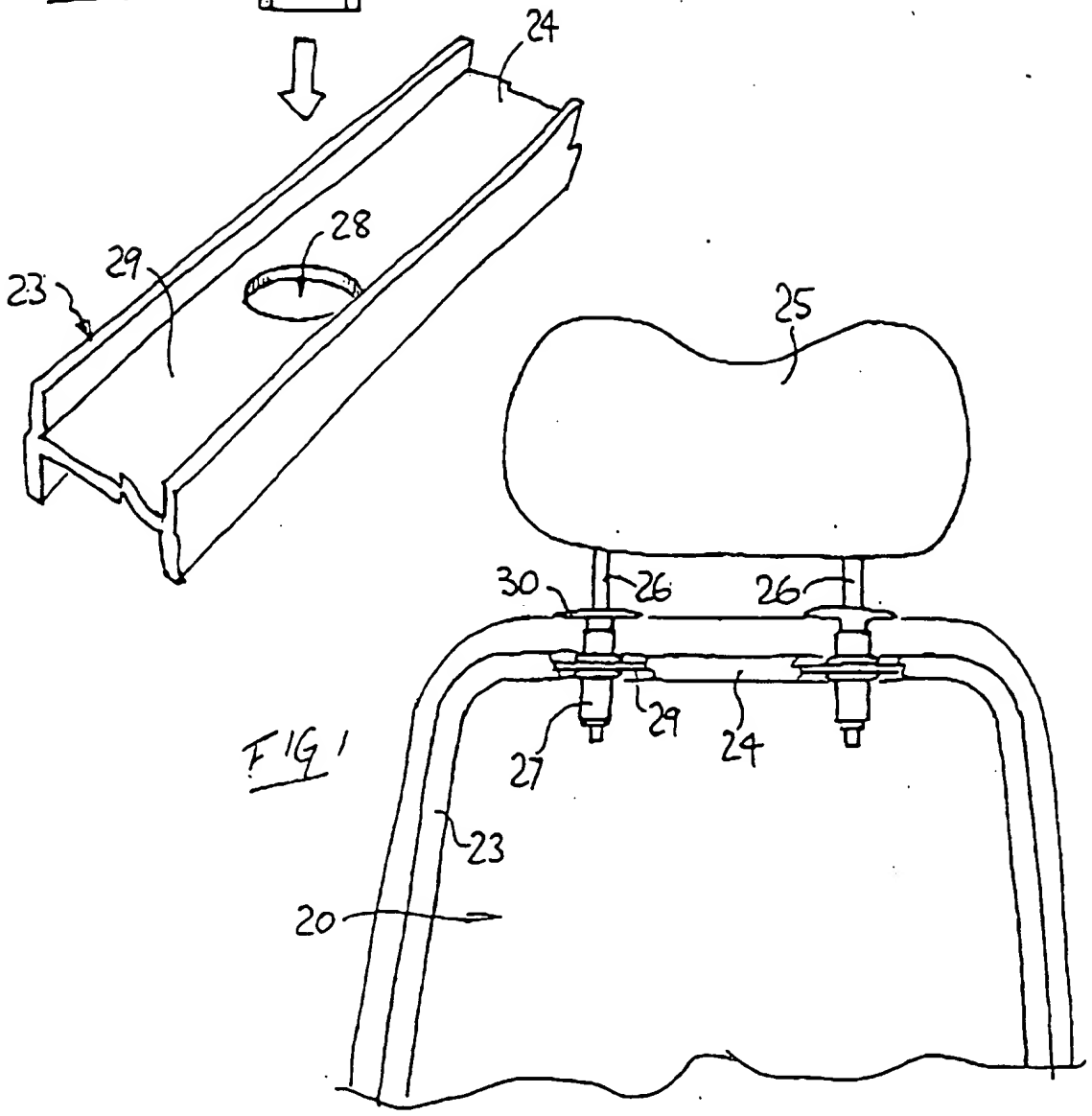

FIG 1

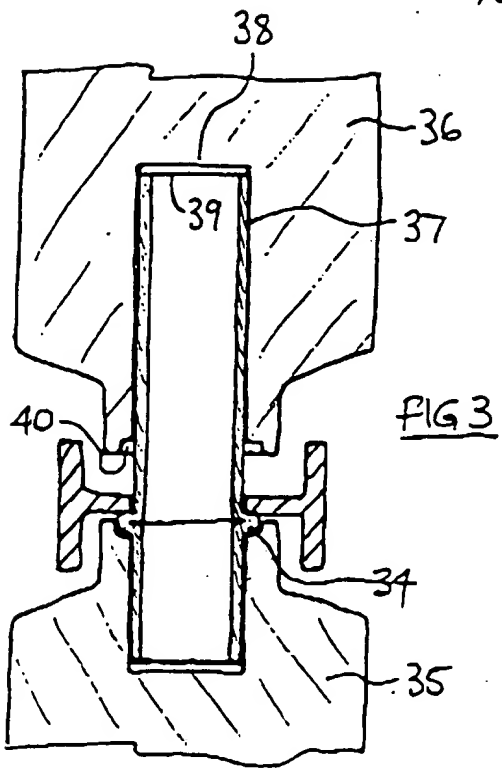

FIG 3

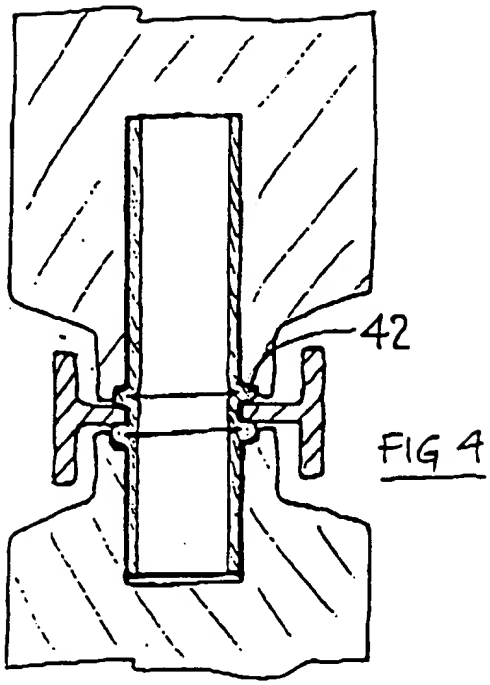

FIG 4

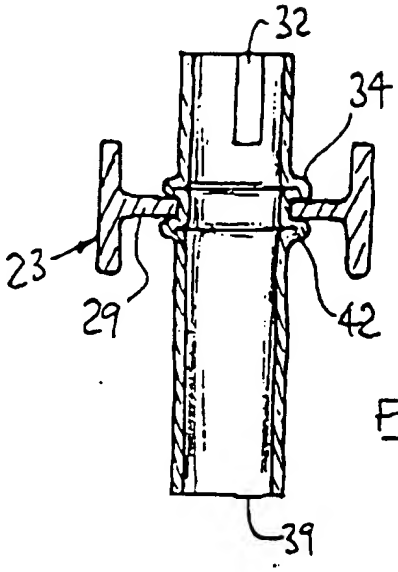

FIG 5

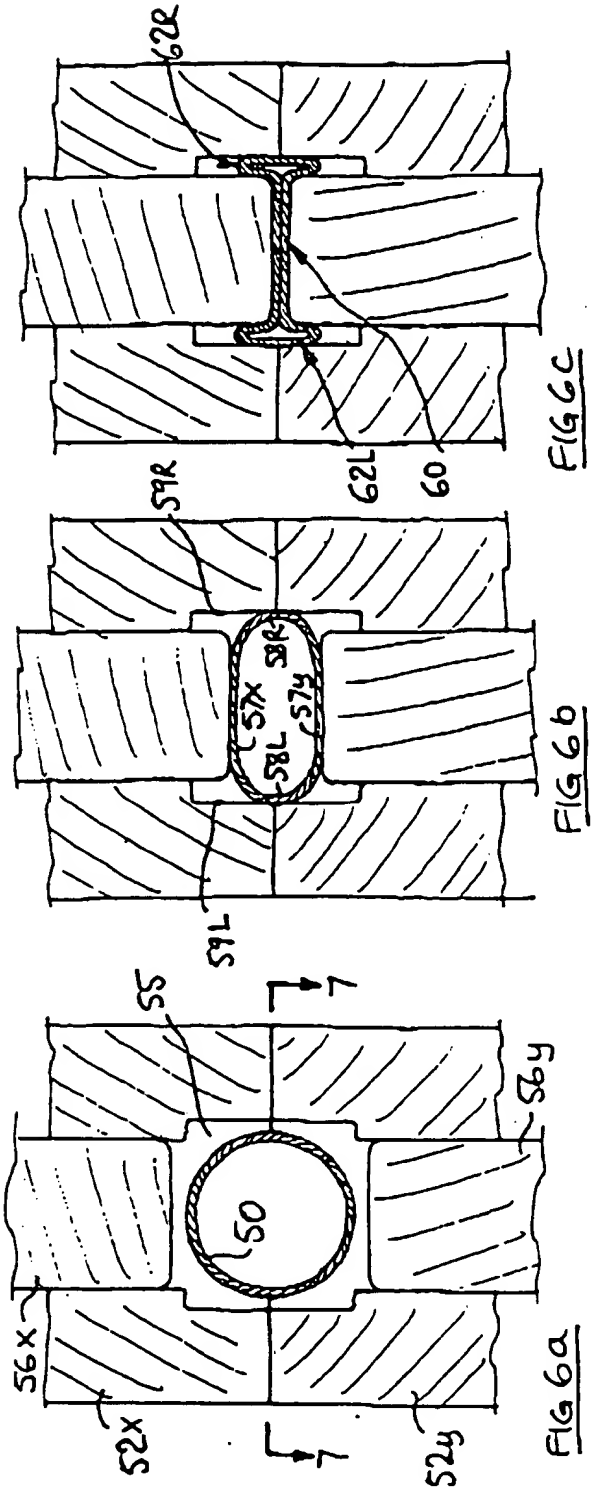

FIG 6c

FIG 6b

FIG 6a

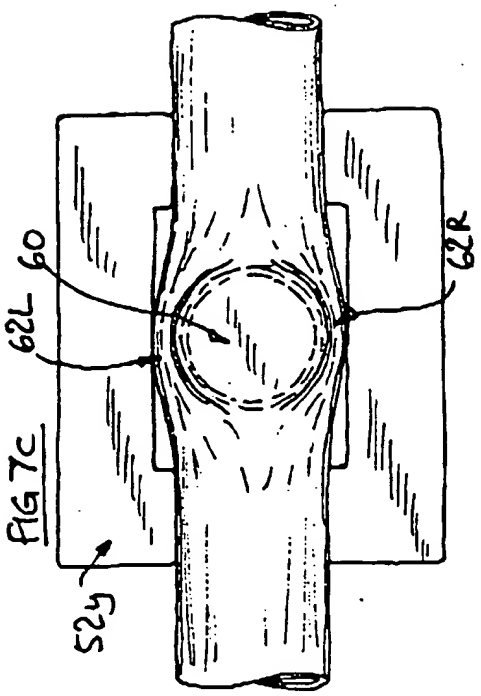

FIG 7c

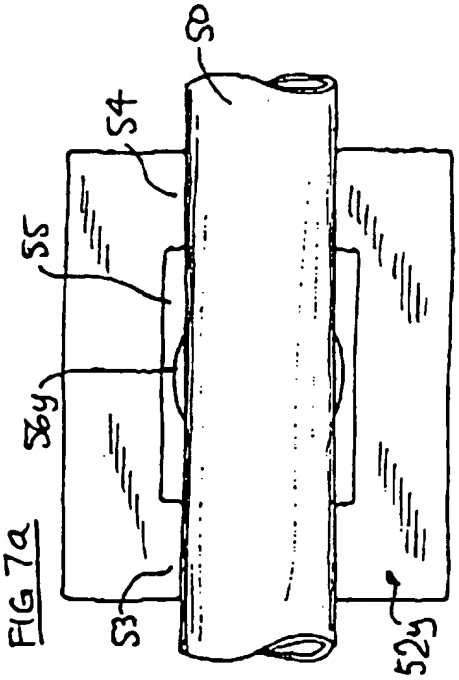

FIG 7a

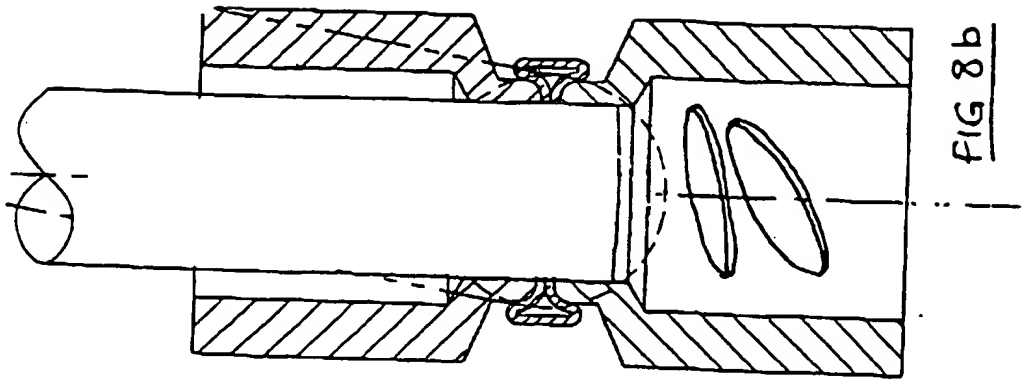

FIG 8b

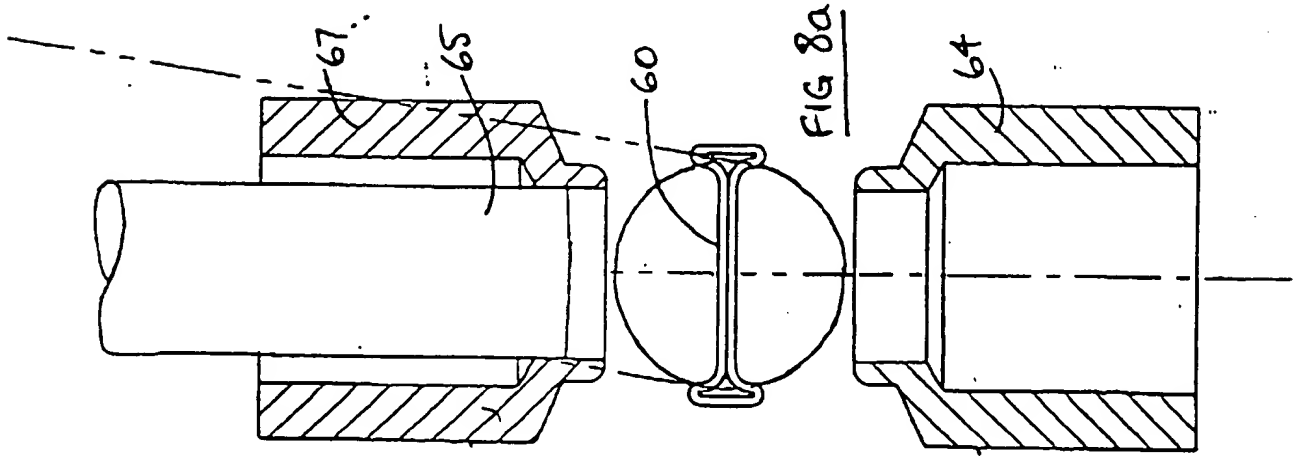

FIG 8a

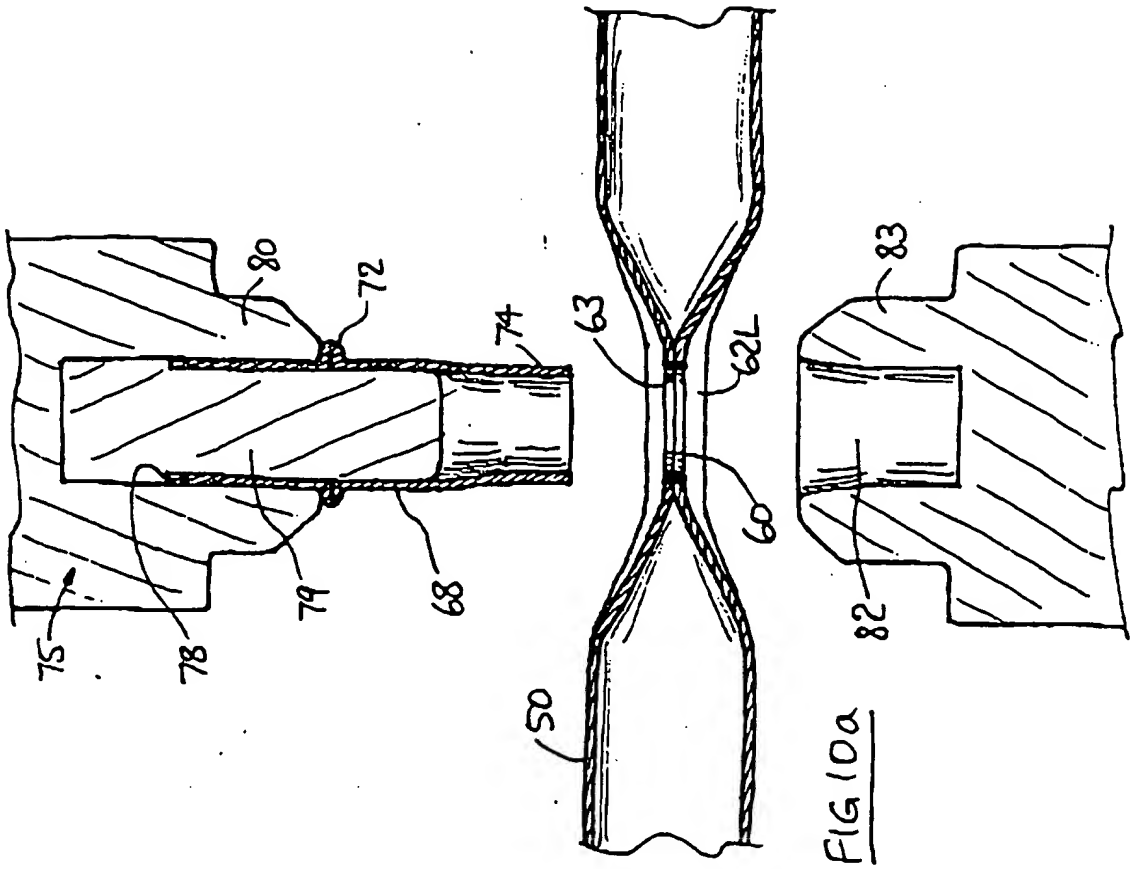

FIG 10a

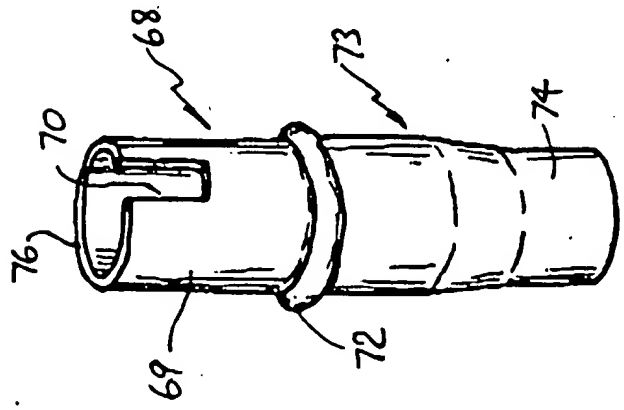

FIG 9

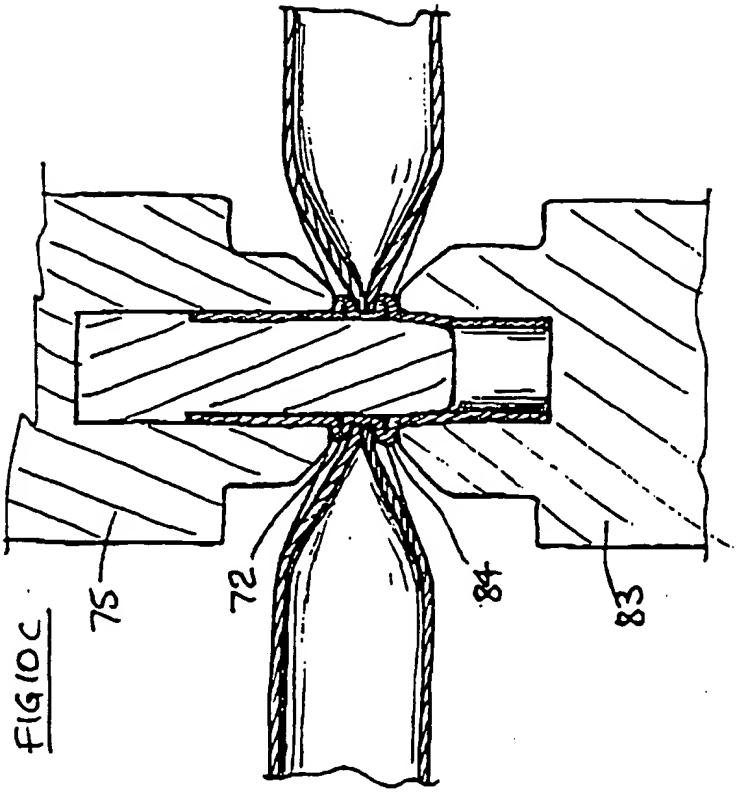

FIG 10C

FIG 10B

Title: SECUREMENT OF HEAD REST SUPPORT INTO AUTOMOBILE SEAT FRAME

This invention relates to the construction of automobile seats, and is directed particularly to the manner of attachment of a headrest to the frame of an automobile seat.

BACKGROUND TO THE INVENTION

The headrest on an automobile seat is often made adjustable as to height. One common way in which the headrest is mounted on the seat in a way that permits height adjustment is for the headrest to be provided with two downwardly extending pegs, and the pegs engage sockets secured into the frame of the seat. Detent means are usually provided which interact between the pegs and the sockets, whereby the headrest may be set, by the occupant of the vehicle, at one of a number of pre-set heights.

The socket in which the peg is received comprises a metal tube. A plastic liner may be provided in the tube, to act as a bearing material for the peg. In the conventional system, the tube is welded to a bracket, and the bracket is welded to a frame piece of the seat. This manner of attachment, though secure enough (because it has to be secure by regulation), unfortunately is expensive as to the labour time and the materials needed to make it that secure. Any securement system that involves welding tends to be labour-intensive and therefore expensive, besides being difficult to inspect and test. A welded system generally has to be over-engineered.

Also, welding does not lead to high accuracy. The need for accuracy of placement of the headrest on the seat is not high, although the accuracy of the spacing of the pegs and their sockets cannot be too far out; the conventional welded-on system is just about at the limit for accuracy for welding, which means that, when welding is used as the basis of the attachment method, skilled care has to be taken, which in turn does nothing to ease the cost problem.

The invention is aimed at providing a manner of securing a

headrest support tube into a seat frame, in a manner that eases some of the compromises that have had to be resorted to in the conventional systems.

Typically, the operations carried out in a conventional seat manufactory include welding, bending of frame pieces, securing components together, and assembly, all of which tend to have a higher labour content. It is an aim of the headrest support system as described herein, to minimise the labour content of the task of attaching the support tubes to the seat frame piece.

Support tubes for headrests are conventionally attached to the seat frame piece by welding a bracket onto the frame piece, and then welding the tube to the bracket. Sometimes, the tube is pressed into holes in the welded-on bracket; but welding is nearly always resorted to, to assure that the tube remains in position on the bracket. Of course, the tubes can be attached securely enough, but the conventional costs of ensuring that security are high.

GENERAL FEATURES OF THE INVENTION

The invention lies in the manner of attaching the headrest-support-tube. First, the headrest-support-tube is provided with a first ring, in which the metal of the headrest-support-tube is expanded radially outwards. The headrest-support-tube is assembled into a hole in the web of the seat-frame-piece, with the first ring abutting against the web.

The frame-piece, with the headrest-support-tube resting therein, is placed in the die of a punch and die set, with the first ring in the die. The punch then is brought down over the other end of the headrest-support-tube, and a second ring is formed on the other side of the web. When the punch is withdrawn, the web lies gripped between the two rings. Usually, another headrest-support-tube is inserted into the frame-piece, in a similar manner. Then, the seat-frame piece is assembled into a seat, and finally the pegs of the headrest are inserted into the headrest-support-tubes.

THE PRIOR ART

As mentioned, headrest-support tubes are attached to the seat-frame-piece by welding. Sometimes, designers have specified intermediate brackets, rather than just welding the tube to the frame piece.

Techniques for mounting a tube into a through-hole in a piece of sheet metal are commonplace, per se. The broad range of options available include bulk-head fittings generally. Such fittings have included cases where a first bead is provided on the tube on one side of the sheet, then a second bead is swaged into the tube after the tube has been inserted into the through-hole. The technique is commonly known as lock-beading.

In cases where bulk-head fittings are being designed, a common requirement is that the fitting by air- or liquid-tight. It is recognised that the lock-beading technique is not suitable for such cases. It is recognised that lock-beading is highly suitable for cases where mechanical integrity is paramount, rather than sealing. It is also recognised that lock-beading is highly suitable for cases where access to the beads is only to be had from an axial direction, such as a case where flat-access to the through-hole is denied because the through-hole is surrounded by raised flanges.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

By way of further explanation of the invention, exemplary embodiments of the invention will now be described with reference to the accompanying drawings, in which:

Fig 1 is a diagram of an automobile seat frame, shown partly in cross-section, carrying a headrest which is mounted in a manner in accordance with the invention;

Fig 2 is a view of some of the components that support the headrest, shown at a preliminary stage of manufacture;

Fig 3 is a view of a punch and die set-up, which is used at a stage in the manufacture of one of the headrest supports;

Fig 4 is a view corresponding to Fig 3 of another stage during

manufacture;

Fig 5 is a cross-section of the headrest mounting support, shown at a later stage;

Figs 6a,6b,6c are cross-sections of a tooling arrangement for forming a metal tube locally into an I-section beam;

Figs 7a,7c are views on the line 7-7 of Fig 6a, corresponding to the conditions shown in Figs 6a and 6c respectively;

Figs 8a,8b are cross-sections of a hole-punching arrangement, for making a through-hole in the web of the I-beam produced as in Fig 6c;

Fig 9 is a view of a headrest-support-tube, shown prior to final forming;

Figs 10a,10b,10c are cross-sections of a tooling arrangement for ring-bead-locking the headrest-support-tube of Fig 9 into the through-hole in the web of the I-beam.

The apparatuses shown in the accompanying drawings and described below are examples which embody the invention. It should be noted that the scope of the invention is defined by the accompanying claims, and not necessarily by specific features of exemplary embodiments.

Fig 1 shows an automobile seat 20, having a seat frame piece 23. In this case, the seat frame piece 23 made from a length of extruded I-section aluminum. The seat frame piece is bent generally into an inverted U-shape, as shown, in which the horizontal rail 24 of the U-shape forms the horizontal top rail of the seat.

The headrest 25 of the seat 20 is formed with two pegs 26, which protrude downwards, as shown. The pegs engage into support tubes 27, which are integral with the frame of the seat. The support tubes 27 are fixed firmly to the horizontal rail 24, and in fact the support tubes pass through holes 28 in the web 29 of the I-section that forms the rail 24 (see Fig 2).

The invention is concerned with the manner of attaching the support tubes 27 into the holes 28 in the web 29 of the I-section. Usually, headrests are adjustable as to vertical position, and the adjustment is effected by moving the headrest, with its two pegs 26, vertically up or down within the tubes 27.

The designer can provide a plastic sleeve 30, which is inserted into the support tube to provide a bearing for guiding the pegs for up/down adjustment movement. The designer can provide the pegs with detents (not shown), which interact with the plastic sleeves 30, or with the tubes 27, in order to define some vertical positions to which the headrest might be set. It is usually necessary to align the plastic sleeve orientationally with respect to the tube, and the plastic sleeve can be moulded with a tongue for engagement with a notch 32 (Fig 5) in the tube, for this purpose.

In order to manufacture the seat frame, with the headrest support tubes 27 attached, first the tubes are formed with a single first swaged-out ring 34. The tube in this state is as shown in Fig 2.

The swaged-out ring 34 is formed by pressing the ends of a plain length of tubing axially, and confining the walls thereof everywhere but at the place where the ring is to be formed. It may be noted that this first operation is carried out on the tube when only the tube itself is present, i.e in the absence of any other components. The operation of forming the first ring is of low labour content, and can be easily automated.

The job of attaching the tube 27, with its first swaged-out ring 34, into the hole 28 in the web 29 of the I-section, can also be fully automated, as can the job of swaging the first ring into the tube. This may be compared with the job of welding a bracket onto the frame piece, and then locating a tube into holes in the bracket, and then welding the tube to the bracket, in which the labour content is inevitably high.

Fig 3 shows the tube 27, with its first swaged-out ring 34, resting in a die 35. The seat frame piece 23 has been placed over the tube 27, with the web 29 resting against the first ring 34. A punch 36 is advanced, and a hole 37 in the punch slides over the upper portion of the tube 27. When the end of the hole 38 bottoms against the end 39 of the tube 27, further movement of the punch causes the upper portion of the tube to be compressed. A recess 40 in the punch allows the metal of the tube to expand outwards, in response to the axial force, with the result that the action of the punch causes a second ring 42 to be formed in

the tube.

Fig 4 shows the situation when the punch and die are (almost) closed fully together. It will be seen from Fig 4 that the web 29 is not contacted by either the die 35 or the punch 36 during the operation of swaging out the second ring 42. At the very end of the operation, the designer might provide that the web is in fact subjected to a squeeze between the punch and die, as a coining phase to ensure everything is straight; but in general, throughout the pressing stages indicated in Figs 3 and 4, the web 29 floats. As the pressing operation is nearing completion, the press forces also act on the first ring 34, and cause that to be consolidated and even coined.

The hole 28 in the frame piece is a clearance fit over the diameter of the tube 27, and so the frame-piece is not held in position, during the Fig 4 operation, by being held by a tight fit on the tube 27. Therefore, the frame-piece 23 does need to be held -- at least loosely -- to prevent tipping thereof. However, that kind of holding is simple enough -- at least when compared with securing the components in welding jigs.

It is important, during the Fig 4 pressing operation, that the web 29 remain resting in close touching contact with the first ring 34. In an automated system, the designer should ensure that the components are presented properly to each other for the operation. Seat-frame-pieces can include bends and twists, and be of an awkward shape, but the designer can provide the holding-clamps etc to accommodate whatever shape the seat-frame-pieces are in. The designer can decide whether to insert the head-rest-support-tubes into the seat-frame-piece before or after the seat-frame-piece is bent and twisted to its final shape.

The designer should ensure that, whatever the configuration of the components, the web can and does rest properly (i.e in firm abutment) against the first ring during the operation of pressing the second ring: if there were to be some clearance between the web and the first ring during pressing, the final joint would be significantly less tight and secure. The ideal is that the web should be under some degree of residual compression after the punch and die have separated, even if only slightly, and that can

only happen if the web remains cleanly in abutment against the first ring throughout the pressing operation.

In an alternative, the die and punch set may be arranged with a subsidiary actuable member, which loads the web tightly against the first ring while the forming of the second ring is taking place.

It is important also that the clearance between the hole 28 in the web and the diameter of the tube 27 be taken up during the pressing operation. The force that causes the metal of the tube to swell out to form the second ring 42, of course also causes the metal to swell out to fill the clearance at the hole 28. Generally, the filling of the hole 28 is so good that any crannies etc caused by burrs or other malformations arising from the punching of the hole 28, are filled completely and tightly.

The manner as described above of attaching the headrest support tubes to the seat frame provides a very secure attachment, which is amply able to accommodate the forces and abusive forces encountered in automotive seating equipment. The material costs are somewhat reduced, and the labour costs are very much reduced, as compared with what has to be done in the conventional tasks of welding the tubes to the frames.

It is conventional for the frames of automobile seats to be made from steel tubing. The head-rest-support-posts can be attached into a tubular-steel seat-frame in the manner as will now be described.

Figs 6a,6b,6c are views directed axially along the length of the seat-frame-tube 50, and show three stages in the preparation of the seat-frame-tube. Figs 7a,7c are views corresponding to Figs 6a,6c in the direction of arrows 7-7 of Fig 6a.

In Fig 6a, the seat-frame-tube 50 has been gripped on its outside diameter between two dies 52x,52y. The dies are dimensioned to grip the seat-frame-tube at two spaced locations 53,54. The dies 52x,52y are shaped so as not to directly grip the seat-frame-tube 50 in the recess 55 between the locations 53,54.

Once the dies 52x,52y are in contact, and the seat-frame-tube 50 is firmly held, the two formers 56x,56y are advanced. At first, the seat-frame-tube 50 is flattened, as shown in Fig 6b. As the upper and lower zones 57x,57y of the tube walls are forced together, the left and right side-zones 58L,58R are forced apart, and these zones of the walls come into contact with the sides 59L,59R of the recess 55.

The formers 56x,56y are advanced until they bottom against the two thicknesses of the wall-zones 57x,57y, as shown in Figs 6c,7c. The wall-zones 58L,58R are formed to the shape as shown by virtue of their confinement by the sides 59L,59R of the recess 55. It will be noted that this manner of forming the seat-frame-tube produces a localised shape which is similar to that of an I-beam. The web 60 of the I-beam shape is derived from the wall-zones 57x,57y, and the flanges 62L,62R of the I-beam are derived from the folded wall-zones 58L,58R.

It is noted that the seat-frame-tube 50 is not simply squashed flat. The operations as described produce a configuration that is much stronger and more rigid than a flattened tube. The flanges 62L,62R, being tall (i.e the height of the flanges is equal to several thicknesses of the walls of the tube), are crucial to the rigidity of the tube against bending forces, which of course is an important consideration in a seat frame.

A hole 63 for receiving the head-rest-support-tube is punched in the web 60 of the seat-frame-tube, in the manner as shown in Figs 8a,8b. A die-button 64 is brought into contact with one side of the web 60. A punch 65, carried in a stripper 67, is advanced, and pierces the hole 63 in the web. The die-button 64 and the stripper 67 are dimensioned to hold the web 60 to its desired shape during the disruption caused by the punching operation and subsequent stripping of the web from the punch 65.

The head-rest-support-tube 68 that is to be secured into the hole 63 in the web 60 is shown in Fig 9. The head-rest-support-tube 68 is of steel, and includes an upper section 69, in which is cut a notch 70, a first ring-bead 72, and a lower section 73, the bottom section 74 of which is swaged down to a slightly smaller diameter than the rest of the head-rest-support-tube. The inside

diameter of the bottom section 74 is dimensioned to be a tight location-fit on the peg 26 of the head-rest, and the reduced outside diameter of the bottom section 74 ensures an easy placement of the head-rest-support-tube 68 into the hole 63 in the web 60 of the seat-frame-tube 50.

The manner of installing the head-rest-support-tube 68 into the hole 63 is illustrated in Figs 10a,10b,10c. The head-rest-support-tube is first positioned into a punch unit 75. The top end 76 of the head-rest-support-tube abuts against a shoulder 78 of the punch 79, and the already-formed first ring-bead 72 abuts against the bottom face of the punch-holder 80.

As shown in Fig 10b, the head-rest-support-tube passes through the hole 63, and the tapered bottom end of the head-rest-support-tube enters the recess 82 in the die 83. As the punch 75 and die 83 approach, the bottom end of the head-rest-support-tube abuts against the bottom of the recess 82. From then on, further approaching movement of the punch and die are reacted as an axially-directed compressive force on the head-rest-support-tube. The compressive force is enough the cause the walls of the head-rest-support-tube to buckle outwards, whereby the second ring-bead 84 is formed. Approaching movement of the punch and die continues until the condition of Fig 10c is reached.

The punch and die are then withdrawn, and the seat-frame-tube 50, with the head-rest-support-tube 68 now firmly attached, can be transferred to the next stage in the manufacture of the seat.

The manner of attaching the head-rest-support-tube into the seat-frame-tube ensures that the web 60 is structurally unitary with the head-rest-support-tube. The first and second ring-beads 72,84 grip the web between them, providing a secure base for resisting abusive forces from any direction, which might tend to disrupt the attachment.

By forcing the punch unit 75 and the die 83 hard together (Fig 10c) the amount of spring-back upon release can be made very small, whereby the compressive grip on the web is still firmly present upon release.

The head-rest-support-tube might be subjected to forces tending to rotate it, during use of the automobile, and it is important that rotation forces are resisted. If rotation of the head-rest-support-tube were to be permitted, the movement might cause the attachment to rattle or work loose. Accordingly, the designer might prefer to make the hole 63 in the web slightly non-circular. In fact, given the fact that the hole occupies a large area of the tube, it is all too easy for the hole 63 to be non-circular in any event. The operation of forming the second ring-bead 84, however, ensures that the head-rest-support-tube adapts itself completely to whatever out-of-roundness there might be in the hole 63, which helps to ensure freedom from rotation of the head-rest-support-tube.

The attachment system as described is very strong, as compared with the conventional welded construction, but apart from that clear advantage, the attachment system provides excellent and repeatable accuracy. Now that accuracy of alignment of the two head-rest-support-tubes can be relied upon, the design of the head-rest detents can be free of the compromises needed with the conventional welded attachment; designing a detent is a matter of making sure the force to move the head-rest pegs against the detent is neither too light nor too heavy, and the more accurately the components can be positioned, the easier it is to ensure the correct force.

Not only is the attachment system as described very strong, and accurate, but the system also lends itself to full automation. The attachment system is in keeping with the kinds of operations that have to be carried out on seat-frame-tubes, such as bending, piercing, etc, and the machinery for automating such operations is already commonplace. The similarity of those frame-tube operations with the operations required in the attachment system will be clear: the dis-similarity of the frame-tube operations with the conventional welding attachment system, is even more clear.

Claims

CLAIM 1. Procedure for attaching a headrest-support-tube, being of a ductile metal, to an elongate frame-piece comprising a top rail of an automobile seat, including the steps of:

providing the headrest-support-tube with a first ring-bead, in which the metal of the headrest-support-tube is expanded radially outwards;

providing the seat-frame-piece in the configuration of an I-beam, being a configuration that comprises a web between two flanges;

providing a through-hole in the web of the seat-frame-piece, the through-hole being a clearance fit over the headrest-support-tube;

making a sub-assembly by placing the headrest-support-tube in the through-hole in the seat-frame-piece, in such a manner that the first ring-bead abuts one side of the web of the seat-frame-piece;

providing a punch and die set;

placing the sub-assembly comprising the headrest-support-tube and the seat-frame-piece in the die set;

arranging the punch and die set so as to confine the headrest-support-tube against radial expansion, except in the region of the headrest-support-tube that lies immediately contiguous with the web of the seat-frame-piece, being a region on the other side of the web from the side against which abuts the first ring-bead;

compressing the headrest-support-tube axially in the punch and die set, while the headrest-support-tube remains in the hole in the web of the seat-frame-piece, and the first ring-bead remains in abutment with the one side of the web, the axial direction being the direction of the axis of the through-hole in the web of the seat-frame-piece;

compressing the headrest-support-tube with enough force whereby the metal of the headrest-support-tube expands outwards in the said region, and forms a second ring-bead on the headrest-support-tube, and whereby the second ring-bead lies in direct contact with the web, on the other side of the web;

taking the sub-assembly out of the punch and die set, leaving the web gripped between the first and second ring-beads.

CLAIM 2. Procedure of claim 1, including forming the first ring by the steps of:
providing a preliminary punch and die set, for applying axial force to the headrest-support-tube, wherein the punch and die thereof are so dimensioned as to confine the tube against radial expansion during axial pressing, except for a recess therein;
compressing the headrest-support-tube axially in the preliminary punch and die set;
whereby the metal of the tube expands into the recess, and forms a first ring on the tube;
and taking the tube out of preliminary punch and die set.

CLAIM 3. Procedure of claim 1, wherein:
the top-rail of the frame-piece is of a cross-sectional shape that is generally relatively large as to its dimensions in the said axial direction;
the web of the frame piece, in the marginal area surrounding the through-hole, is flat, and is relatively thin in the said axial direction;
and the metal of the web in the said marginal area is so disposed as to be able to resist heavy axial compressive forces without distortion.

CLAIM 4. Procedure of claim 3, wherein:
the top-rail of the frame-piece has a profile of such configuration and shape that portions of the profile surround the said marginal area of the web, being portions of much greater axial extent than the web;
whereby the marginal area of the web is an axially thin area located between portions of the profile that are axially much larger.

CLAIM 5. Procedure of claim 4, wherein the portions of axially larger profile are disposed both sides of the web.

CLAIM 6. Procedure of claim 1, wherein the procedure includes the step of inserting two of the said headrest-support-tubes into the top rail.

CLAIM 7. Procedure of claim 1, wherein the seat-frame-piece is a

length of metal in the form of an I-section, and the web is the bar of the I-section.

CLAIM 8. Procedure of claim 1, wherein the seat-frame piece is a length of metal in the form of a round seat-frame-tube, and the web is a local area of the seat-frame-tube that has been squeezed flat.

CLAIM 9. Procedure of claim 8, wherein:
the web of the seat-frame-tube is formed by progressively squeezing the seat-frame-tube locally between formers, in a die;
the die confines the seat-frame-tube against expansion in the direction perpendicular to the direction of squeezing;
the formers are sufficiently smaller than the confines of the die as to leave room for the walls of the tube to fold over into flanges.

CLAIM 10. Procedure of claim 1, including the step of making the through-hole in the web of a non-round configuration.

CLAIM 11. Procedure of claim 1, including the step of assembling the sub-assembly into an automobile seat.

CLAIM 12. Procedure for manufacturing an automobile seat with a headrest, including attaching a headrest-support-tube, being of a ductile metal, to an elongate seat-frame-piece comprising a top rail of an automobile seat, by means of the following steps:
attaching the headrest-support-tube into the seat-frame-piece by the procedure of claim 1;
attaching a second headrest-support-tube into the seat-frame-piece, alongside, by the procedure of claim 1;
assembling the seat-frame-piece with the two headrest-support-tubes into an automobile seat;
providing a headrest, the headrest having pegs;
and assembling the pegs of the headrest into the headrest-support-tubes.

CLAIM 13. A frame for an automobile seat, which includes a headrest-support-tube, mounted in a seat-frame-piece of the

automobile seat, wherein:
the seat-frame-piece includes a portion that has a cross-section of I-beam configuration, comprising a web and side-flanges;
the web is relatively thin, and has a through-hole, which extends right through the material of the web;
the headrest-support-tube lies in the through-hole;
the headrest-support-tube has a first ring-bead, comprising a local radial expansion of the material of the headrest-support-tube, and the first ring-bead lies in abutment with the material of the web, on one side of the web;
the headrest-support-tube has a second ring-bead, comprising a local radial expansion of the material of the headrest-support-tube, and the second ring-bead lies in abutment with the material of the web, on the other side of the web;
and the first and second ring-beads are so arranged in relation to the web as to grip the material of the web tightly therebetween.

CLAIM 14. Apparatus for attaching a headrest-support-tube, which is of a ductile metal, to an elongate frame-piece comprising a top rail of an automobile seat, wherein:
the headrest-support-tube is formed with a first ring-bead, in which the metal of the headrest-support-tube is expanded radially outwards;
the seat-frame-piece is in the configuration of an I-beam, being a configuration that comprises a web between two flanges;
the web of the seat-frame-piece is provided with a through-hole, the through-hole being a clearance fit over the headrest-support-tube;
the apparatus includes means for making a sub-assembly by placing the headrest-support-tube in the through-hole in the seat-frame-piece, in such a manner that the first ring-bead abuts one side of the web of the seat-frame-piece;
the apparatus includes a punch and die set;
the apparatus includes means for placing the sub-assembly comprising the headrest-support-tube and the seat-frame-piece in the die set;
the apparatus includes means for arranging the punch and die set so as to confine the headrest-support-tube against radial expansion, except in the region of the headrest-support-tube that lies immediately contiguous with the web of the seat-

frame-piece, being a region on the other side of the web from the side against which abuts the first ring-bead;

the apparatus includes means for compressing the headrest-support-tube axially in the punch and die set, while the headrest-support-tube remains in the hole in the web of the seat-frame-piece, and the first ring-bead remains in abutment with the one side of the web, the axial direction being the direction of the axis of the through-hole in the web of the seat-frame-piece;

the apparatus includes means for compressing the headrest-support-tube with enough force whereby the metal of the headrest-support-tube expands outwards in the said region, and forms a second ring-bead on the headrest-support-tube, and whereby the second ring-bead lies in direct contact with the web, on the other side of the web;

the apparatus includes means for taking the sub-assembly out of the punch and die set, leaving the web gripped between the first and second ring-beads.

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): B3V,B3A

Int Cl (Ed.6): B21D 53/00,47/00

Other: On line databases WPI,EDOC,JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2291368 A	Summers see Fig 1	Claims 1,12,13,14 at least
A	GB2111411 A	MTU see Fig 1	"
A	GB 921893	Belling see Fig 2	"

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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